TECHNICAL UNIVERSITY OF MOMBASA

FACUULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL ENGINEERING DEPARTRMENT

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE2511: POWER SYSTEM ANALYSIS I

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory 30 marks)

a)

i. Explain with the aid a sketch the FOUR kinds of power injections to a given bus

ii. State the elements responsible for kinds of power injections above

(6 Marks)

b) Show that for a TWO bus system the power flow equation is given by:

$$P_p = |V_p|^2 G_{pp} + |V_p||V_q|G_{pq}\cos(\theta_p - \theta_q) + |V_p||V_q|B_{pq}\sin(\theta_p - \theta_q)$$

$$Q_p = -|V_p|^2 B_{pp} + |V_p||V_q|G_{pq}\sin(\theta_p - \theta_q) - |V_p||V_q|B_{pq}\cos(\theta_p - \theta_q)$$

(8 Marks)

c)

i. Highlight any THREE challenges faced by power transmission planners in a developing country

ii. State THREE important stakeholders in power system planning

(6 Marks)

d) Determine the Y matrix for the Five Bus power system Figure 1 below:

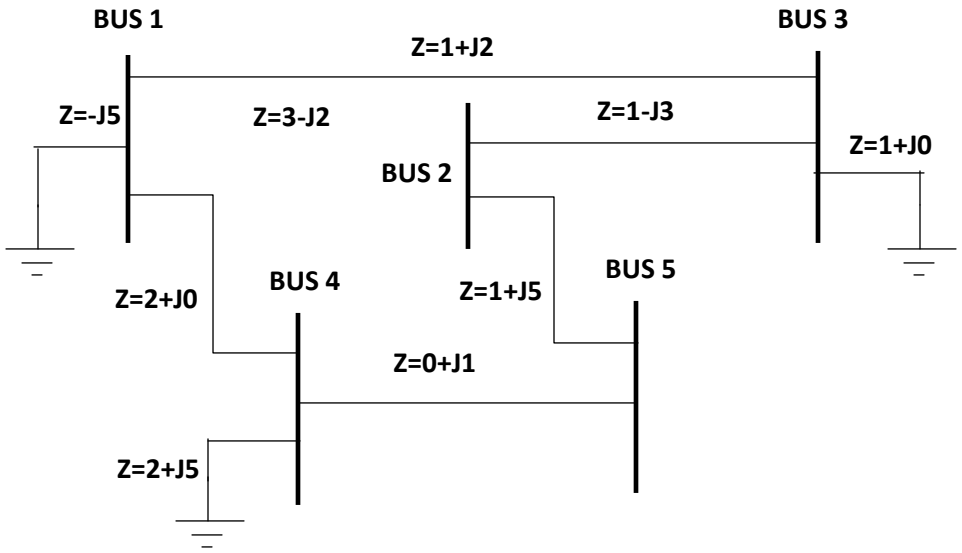

Figure 1

(10 Marks)

Question TWO

a)

i. State any FOUR benefits provided by digital computer in load flow analyses

ii. Explain FOUR limitations of Fast Decoupled Load flow algorithms

(8 Marks)

b) Show that for Fast Decoupled Load Flow technique:-

$$\frac{\Delta P}{\Delta V}=[B']\Delta\theta$$

hence determine voltage and angle after TWO iterations for a –bus system having Y matrix given by:

$$\begin{vmatrix} -34.43 & 14.3 & 20 \\ 14.3 & -24.3 & 10 \\ 20 & 10 & -30 \end{vmatrix}$$

(12 Marks)

Question THREE

a) State any FOUR: -

i. inter-relationship between active power, reactive power, voltage and phase angle of a practical power system during steady state operation

ii. precautions taken while using Gauss-seidel technique in power flow analysis

(8 Marks)

b) A TWO bus system is a shown in Fig 2 below:

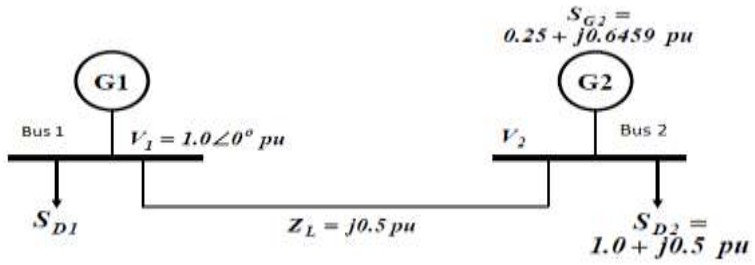

Figure 2

c) The line impedances are as indicated in per unit on 100MVA base. Using Gauss-Seidel method:-

i. Classify each bus
ii. Find bus admittance matrix
iii. Determine bus 2 voltage after FOUR iterations.
iv. Estimate bus 1 real and reactive power.

(12 Marks)

Question FOUR

a)

i. Define load forecasting with respect to power systems
ii. Highlight any FIVE factors causing load changes in a power system
iii. Explain how load forecasting can be classified

(11 Marks)

b) The admittance matrix of a power system is given as:

$$Y_{bus} = j\begin{bmatrix} -13 & 5 & 4 & 0 \\ 5 & -13.5 & 2.5 & 2 \\ 4 & 2.5 & -9 & 2.5 \\ 0 & 2 & 2.5 & -4.5 \end{bmatrix} \text{ per unit}$$

c) Given that current voltages V_1, V_2 V_3 and V_4 are 1 p.u each in magnitude and corresponding angles are 0^o, 20^o, 30^o and -45^o respectively, estimate the load forecast in t = 10 years assuming a exponential load growth given by $I = ce^{dx}$ where constants c and d are 1.2, and 2 respectively

(9 Marks)

Question FIVE

a)

i. State any THREE assumptions made while using Newton Raphson algorithm for load flow analysis
ii. State TWO advantages and TWO disadvantages of Newton Rapson Technique for power flows over Gauss Seidel

(7 Marks)

b) A THREE bus power system is as shown in Figure 3 below:

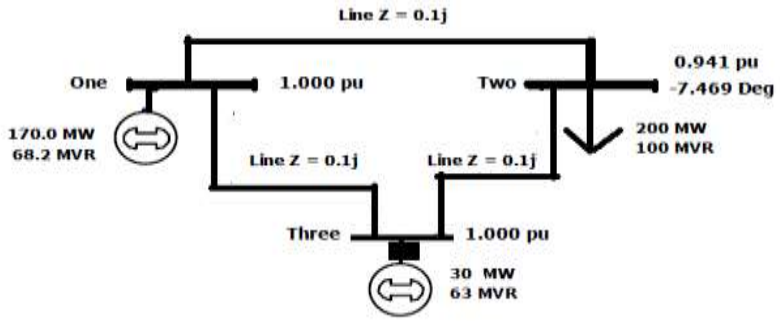

Figure 3

Apply the Newton- Raphson power flow to determine the voltage magnitude and angle at bus two. Assume that bus one is the slack and take base of 100 MVA

(13 Marks)